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CBSE 7201

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Annotations:

1. **Exercise and children’s Intelligence, Cognition and Academic Achievement:**

Studies that examine the effects of exercise on the intelligence, cognition and academic achievement of children were reviewed and the results were discussed under lens of (a) contemporary cognitive theory development directed toward exercise, (b) recent research demonstrating the salutary effects of exercise on adults’ cognitive functioning and (c) studies conducted with animals that have linked physical activity to changes in neurological development and behavior. Similar to adults, exercise facilitates children’s executive function which is the process required to select, organize, and properly initiate goal-directed actions. Exercise may prove to be a simple, yet important method of enhancing those aspects of children’s mental functioning central to cognitive development (Tomporowski, Davis, Miller & Naglieri 2007).

Cognition is a board term that reflects a number of mental processes. Colcombe and Kramer (2003) conducted a theory driven meta-analysis of 18n studies designed to assess the impact of physical activity on older adults’ cognitive performance. Tasks used in these studies were coded in terms of four specific types of mental processing; executive function (scheduling response inhibition, planning and working memory); controlled processing (the automatization of response sequence learning (Chodzko-Zajko & Moore 1994)), Visuospatial processing (perceptual learning (Stones & Kozma 1989)) and speed processing (simple reaction time (Spiduso & Clifford 1987)). The result analysis in this study revealed that aerobic exercise resulted in a moderately large effect on overall cognitive performance.

The executive function hypothesis supports the idea the executive functioning is not a unitary process. It is rather a number of more elemental underlying processes. Evaluation of adults’ performance on test of executive function reveal that there are three variables which are moderately correlated that can be separated; set shifting, which requires individuals to disengage processing operations of an irrelevant task and engage operations involved in a relevant task; updating which is closely related to working memory and the need to monitor representations; and inhibition, which involves the deliberate suppression of a prepatent response (Miyake 2000).

Strong support for the executive function hypothesis has been provided through research conducted with older adults. Kramer assessed the impact of aerobic exercise training on both executive and non-executive cognitive processes in older adults. Participants in this study were assigned to either a 6-month aerobic training program or a non-aerobic toning program. A battery of cognitive tests was administered to participants prior to and following interventions. Individuals who participated in aerobic exercise training performed tests that required executive function (i.e., category switching, flanker test, and countermanding task) more rapidly and more efficiently than non-exercisers. Most importantly treatments had negligible impact on older adults’ performance of task that did not emphasize mental processes (pursuit rotor task, digit-digit matching, spatial attention task) (Kramer 1999).

More recently Colcombe used magnetic imaging technique (Fmri) to assess brain function of 29 sedentary older men prior to and following a 6-month aerobic walking program. Physical activity modified brain function in the anterior cingulate cortex., prefontal corical area implicated in the regulation and control of behavior. Men who exercised were able to perform a complex decision task more rapidly compared to those who did not exercise (Colcombe 2004).

In conclusion, executive functions are involved in performing goal-directed actions in complex stimulus environments, especially novel ones in which elements are constantly changing. These behaviors have been seen as important for children’s adaptive functioning. Exercise training programs may prove to be simple yet important methods of enhancing aspects of children’s mental functioning that are central to cognitive and social development. Many questions concerning the relationship between exercise and cognitive development remain unanswered. It is unknown whether improvements in cognition caused by exercise are maintained following the termination of physical activity or if they decline (Tomporowski, Davis, Miller & Naglieri 2007).

1. **The Obesity Epidemic How non-PE Teachers can improve the Health of their Students:**

The national center for chronic disease prevention and health promotion reports that the number of overweight young children and adolescents aged 6-19 years old has more than doubled in the past twenty years. Obesity is for the most part a consequence of a sedentary life style. Although thyroid gland problems and genetics can also lead to obesity, these are relatively uncommon. For a vast majority of over-weight children, the real reason is the education system. This is the way they have been conditioned to live. Many experts estimate that nearly 80 % of obese children will stay that way into adulthood (Shublak 2004). As these children age they encounter a variety of short term and long term problems. Immediate consequences of extreme weight gain are fatigue, shortness of breath, lack of motivation, all of which lower concentration levels and make it more difficult to learn (Yaussi 2005). The keys to combating obesity are not as difficult as they may seem. Physical exercise and good nutrition are the key factors to good physical and therefore mental health.

Overweight and obese children will inevitably miss more days of school for medical reasons. These absences mean that students will be forced to catch up on material, increasing the risk of not fully understanding concepts. Also, the students who experience obesity will lack energy to remain on task and sustain concentration needed to process information.

There are many ways in which classroom teachers can combat this dilemma. One way in which teachers can go about this is decrease the amount of time students have to fit behind a desk for this encourages sedentary behaviors. Teachers need to implement small changes into their routines to include more physical movement within the classroom. If the 45-minute aerobics class is unavailable, teachers need to have students get away from their seats several times a day. Teachers can use their classroom as a place to simultaneously promote hands on activities and movement. One activity that Shublack suggests for middle and high school children is incorporating math skills into hip-hop dance movements (Shublack 2004).

1. **Training augments resistance exercise induced elevation of circulating brain derived neurotrophic factor (BDNF)**

BDNF (brain derived neurotrophic factor) induces neurogenesis, protects against neurodegeneration and positively influences neural plasticity within the hippocampus, resulting in improved learning and memory (Yarrow, White, McCoy & Borst). A growing body of evidence indicates that participation in physical exercise induces neurobiological adaptations that result in a reduced severity depression and improved cognitive function, including memory.

This study tested the hypothesis that resistance exercise elevates circulating BDNF. Twenty healthy untrained college males underwent a 5-week traditional or eccentric-enhanced progressive resistance training intervention. Blood samples were obtained to collect data. The results were that BDNF increased 77% in response to the standardized resistance exercise about (p<0.01) and returned to resting values within 30 minutes. Ultimately the change in the serum BDNF fro resting to immediately post-exercise was 98% greater at post-intervention that at baseline (p<0.05). This study is the first to demonstrate that resistance exercise induces a robust, yet transient elevations of circulating BDNF and that progressive resistance augments this response; perhaps demonstrating one mechanism through which exercise influences brain health (Yarrow, White, McCoy & Borst).

1. **Sweating makes you smart**

The brain and body connection is more powerful than one may believe. Exercising not only makes you stronger, healthier and better looking-it also helps your brain overcome any damage that may have occurred and aging factors (Jozefowicz 2004). As a result of brain imaging studies in humans and neurochemical studies in animals, scientist have found evidence that exercise actually makes a stronger brain. Physical exertion induces the cells in the brain to reinforce old connections between neurons and to forge new connections. This denser neuron network is better able to process and store information essentially resulting in a smarter brain.

Much of this research focuses on a protein called BDNF. This chemical helps nerve cells grow and connect. It is an important chemical for fetal development and is also critical in the adult brain. Rats who were boosted with BDNF in their brains navigate mazes faster than cage mates with lower levels. Brain injuries in the high BDNF brain animals heal faster. BDNF also helps rats inhibit a behavior which is considered to be the equivalent to rat depression.

Though brain imaging researchers have been able to show that exercise helps increase BDNF in the brain and therefore increase brain health.

1. **Acute High-intensity exercise induced cognition enhancement and brain-derived neurotrohic factor in young, healthy adults**

Cognition peaks in the early twenties. It is highly influenced by sedentary lifestyle-related health risks such as obesity and fitness. Aerobic exercise has immediate behavioral benefits and when performed on a daily basis, is an effective way to preserve and enhance cognitive functions (Hwang, Brothers, Castelli, Glowacki,, Chen, Salinas, . . . Calvert 2016). Acute exercise causes an increased rate of mitochondrial respiration and cerebral oxygen consumptions which produce multiple beneficial effects such as increase in Brain derived neurotrophic factor (BDNF) and stimulus of the prefrontal cortex function.

This study examined the effect of acute high intensity aerobic exercise on prefrontal dependent cognitive and BDNF. 58 young adults were randomly assigned to one of two experimental groups: (a) an acute bout of high intensity exercise (n=29) or (b) a non-exercise control (n=29). Participants in the exercise group improved performance on inhibitory control in Stroop interference and on cognitive flexibility in Trail Making Test (TMT). Part-B compared with participants in the control group and increased BDNF immediately after exercise. There was a significant relationship between BDNF and TMT Part-B on the pre-post change following exercise. The finding support that there is an association between prefrontal-dependent cognitive performance and increased BDNF in response to acute exercise. The researchers concluded that the changes in BDNF concentration may be partially responsible for prefrontal-dependent cognitive functioning following an acute bout exercise.

1. **Aerobic Exercise includes any form of activity that involves rhythmic, steady movement of the large muscle groups for a period of at least 10 minutes. Aerobic activity includes brisk, walking, biking, dancing, rowing, jogging, swimming, and participating in aerobic classes.**

At the University of Pittsburgh, Kirk Erickson, PhD, and his colleagues assigned 120 previously sedentary older adults to either a moderate-intensity walking group or a stretching-toning group for one year. They found that one year of exercise training increased the size of the hippocampus by two percent in the walking group compared to the stretching toning group. Their findings suggest that the aging brain is "modifiable," and that sedentary older adults can benefit from a moderate walking program.

Resistance Training. University of British Columbia researchers compared the effects of twice-weekly resistance training ([weight lifting](http://go.galegroup.com.ez-proxy.brooklyn.cuny.edu:2048/ps/i.do?&id=GALE|A307078126&v=2.1&u=cuny_broo39667&it=r&p=AONE&sw=w&authCount=1)) and twice-weekly aerobic training (walking) with balance and toning exercises in women 70 to 80 years old. All of the participants had probable mild cognitive impairment (MCI).

Compared with the balance/toning group, the resistance training subjects showed significant improvement on a test that measured attention, conflict resolution, and memory. Resistance training also led to functional changes in three brain regions related to memory.

According to the authors, "Twice-weekly resistance training is a promising strategy to alter the trajectory of cognitive decline in seniors with MCI."

A second research team at the University of British Columbia investigated 1) the simultaneous effect of exercise training and baseline factors on mental function and 2) the effects of exercise training on an individual's probability for mental improvement, maintenance, or decline.

Participants were 155 women, aged 65 to 75, who were assigned to either resistance training or balance and toning groups. Outcomes were determined by the Stroop Test, which measures selective attention and conflict resolution.

The probability of improving or maintaining cognitive function was higher with resistance training in study participants who had higher mental function at the beginning of the study. Overall, those in the balance/toning group had a lower probability of improvement and a higher risk of decline.

\* Combination Training. Researchers in Japan conducted a trial to determine the impact on memory of a 12-month combination program of aerobics, strength training, and balance retraining as compared to education-only classes. Their conclusion: An exercise intervention can improve or maintain cognitive performance in older adults with mild memory impairment.

Dr. Ravdin notes, "This research confirms that even modest increases in activity among sedentary older adults have beneficial effects." However, there is no "one-size-fits-all" recommendation regarding type, amount, or frequency of exercises for brain health. To create an activity plan that is appropriate for you, ask your doctor for assistance. If you have medical conditions such as cardiovascular disease, osteoporosis, rheumatoid arthritis, or Parkinson's disease, work with someone who has experience and training in helping patients with your condition.

An exercise intervention can help improve or maintain cognitive performance in older adults with mild memory impairment (Women's Health Advisor 2012).

1. **EFFECTS OF AEROBIC EXERCISE ON COGNITION AND BIOMARKERS IN ADULTS WITH A DOUBLE-HIT RISK FOR DEMENTIA: MILD COGNITIVE IMPAIRMENT AND PREDIABETES**

There have been findings that aerobic exercise can improve executive function in older adults with amnestic mild cognitive impairment (MCI). We also reported similar benefits of exercise in older adults with prediabetes, a metabolic condition associated with increased risk for Alzheimer’s disease. Individuals with comorbid MCI and prediabetes, and thus with two strikes against them for dementia risk, may represent a particularly vulnerable group with increasing numbers owing to the rising prevalence of type 2 diabetes. Aerobic exercise is a potent insulin sensitizer and epidemiologic evidence indicates that it may slow or prevent AD. No controlled trial to date has examined whether aerobic exercise can correct or ameliorate cognitive decline and disease pathology in this group of adults.

Researchers in this study enrolled 50 sedentary older adults (age range: 55-89 yrs) with amnestic MCI and prediabetes meeting American Diabetes Association criteria for blood hemoglobin A1c levels. Participants were randomized to an aerobic training or a stretching control group, and completed structured exercise under the supervision of a trainer for 45-60 min, 4 times per week for 6 months using community-based facilities. The aerobic group exercised at 70-80% of heart rate reserve (HRR), while participants in the stretching group exercised at an intensity below 35% HRR. At baseline and month-6, participants completed cognitive testing (verbal recall, tests of executive function), a 400m timed walk test, a 2-h glucose tolerance test, body fat measurement, and blood and cerebrospinal fluid collection for biomarker assay.

The results of this study were that 35 of 50 participants who have completed the 6-month protocol indicate 92% adherence, and improved post-intervention fitness and glucose tolerance in the aerobic group relative to controls (p<0.05). Early findings also indicate that moderate-high intensity aerobic exercise results in improved cognitive function, with the strongest benefit observed on tasks involving executive control. Additional cognitive findings, biomarker response, and brain imaging results will be presented. Conclusions: Regular aerobic exercise may be sufficient to slow or delay disease progression in a population of adults with a high potency risk for dementia (Baker, Hansen, Cholerton, Skinner, Sink, Callaghan, . . . Wilson 2014)

1. **A Healthy Body Often Equals a Healthy Brain; Experts stress that exercise, good diet maintain memory as much as mental challenges do.**

A healthy body is key to maintaining a heathy brain which many people tend to overlook. An estimate of 47 million people worldwide live with dementia in 2015 and this number is projected to triple by 2050 according to the Alzheimer Association (Thompson 2015). Researchers now believe that micro-strokes (tiny decreases in blood flow to the brain) can add up and over time cause a person to suffer a loss of their faculties. By keeping the brain both healthy and active, a person cane preserve what is called their “brain reserve”. The brain reserve is the ability of the brain to weather various factors including aging. The more the brain reserve a person has the older they can get without showing signs and symptom of memory loss. The Alzheimer Associations suggest above all to engage in regular physical exercise to reduce the risk of brain decline.

1. **Longitudinal evidence that increases in processing speed and working memory enhance children’s reasoning:**

As children develop, their information processing speed (PS) increases and they are able to retain more information in the form of working memory (WM). These changes that develop over time have been believed to drive age related improvements in reasoning and problem solving. in cascade model, developmental change in PS increases the functional capacity of WM, which in turn facilitates reasoning. Studies have shown that developmental increases in PS and WM during childhood and adolescence predict developmental improvements in inductive reasoning and in accuracy on arithmetic word problems (Kale 2007).

1. **Cognitive Development as an executive process in part; a homeopathic dose of Piaget**

Piaget’s theory of cognitive development pertains to the idea that exercise of agency is necessary to the development of self-world dualism and the developing ability to frame explicit judgements about the physical and mental world. The executive function is important to understand why children struggle with certain formal tests. Piaget believed that cognitive development occurred in four stages; sensorimotor, preoperational, concrete operational, and formal operational. Piaget believed that mental development progresses through biological maturation and environmental experience. Children construct an understanding of the world around them and experience discrepancies between what they already know and what discover in their environment. Piaget believed that cognitive development the center or human organism and language is contingent on knowledge and understanding acquired through cognitive development.

Many theories can help support the idea that physical exercise is essential to higher order executive functioning. One great theorist amongst many is Piaget. According to Piaget, no matter how rich the perceptual input and no matter how many and varied are the innately specified modules, subjects will fail to develop mentally if they cannot alter their perceptual inputs at will. This is necessary throughout development. Piaget also emphasizes interactionist. This theory focuses on the idea that the body and the mind have an effect on each other. For an example pricking one’s finger (physical) causes pain (mental). Another example is an embarrassing memory (mental) causes one to blush (physical). Under Piaget’s theory the idea of ‘altering at will’ is not something that can be achieved by physical action such as eye movements because it encompasses shifts of attention which will be seen as a mental action by a Piagetian. Just looking at a house does not help one understand its dimensions (Russel 1999). A person has to look at the house from different angles to understand how the world woSrks and therefore they will be able to understand more complex concepts that can’t be solved simply from visual aid.

1. **Formal Operational Stage of Piaget's Cognitive Development Theory:**

Cognitive development process is the formation and composition of thinking processes. It includes particularly identification, recall, solve difficulties, problems, hindrances, and make decisions about something from childhood to adulthood. Piaget's theory of cognitive development is concerned with information, knowledge and understanding, how a human being gains knowledge, builds knowledge as well as applies knowledge (Wadsworth, 2003). In view of Piaget (1964) cognitive development in early period contains processes which are based upon some actions and in later period cognitive development involves mental operations. Ojose, (2008) asserted that Piaget's theory on cognitive development stages are Sensorimotor (0 - 2 years), Pre operations (2 - 7 years), Concrete operations (7 - 11 years), and Formal operations (12 - 16 years).

Another theorist who believed that the mind and body are connected. He would elicit a response from a dog using a stimulus response approach. In his experiment he would ring a bell and then give the dog food. The ring of the bell was the environmental input(mind) that alerted the dog’s body that food was going to be served and the dog would begin to salivate to get his body ready for digestion. After a few times Skinner the dog would salivate just at the ring of the bell. The dog learned that the sound of the bell meant food and therefore his body would react to that.

1. **Study Faults Gym programs in City Schools**

In a New York times article in 2001, NYC school children are not receiving enough gym time. 4 out 10 schools are failing to provide adequate amount of gym time to children. With lack of space and growing inflation of students, schools are making room for more classrooms rather than gyms. Law states that children from Kindergarten to Third grade are to receive physical education every day however the state counts on the schools to measure their own compliance (Hartocollis, 2001).

1. **Study protocol: The Fueling Learning through Exercise (FLEX) study - a randomized controlled trial of the impact of school-basedphysical activity programs on children's physical activity, cognitive function, and academic achievement (**Oct. 13, 2016)

Physical activity is related to many health benefits. School is an ideal platform to teach the importance of physical exercise due to the fact that children spent much of their childhood in school. However competing demands on teachers’ time, meeting standardized test goals and over crowdedness limits PA programs in schools. There is a growing body of evidence that demonstrates school-time PA is positively associated with academic achievement. Experts have called for a movement called “whole school” to increase children’s PA levels in which recess, in -class PA breaks, before and after school programs, and integration of PA and academics curricula combine to create healthy school environments (Wright, Duquesnay, Anzman-Frasca, Chomitz, Chui & Economos). This approach can increase the time children spend engaging in PA activities to meet the recommendation of 60 min per day, 30 of which are accrued during school hours. Longitudinal evidence of the effects of school-based PA programs on physiological, behavioral, and academic outcomes is limited for racially diverse school children and a few studies have evaluated the impact of changes in MPVA on standardized test scores in this population in the context of random school-based PA intervention programs.

The Fueling Learning through Exercise (FLEX) study is a randomized controlled trial which seeks to evaluate the impact of two innovative school-based PA programs on MVPA (moderate to vigorous physical activity) as well as cognitive and academic outcomes over time among 3rd-5th grade students. This study implemented one of two programs in schools; 100-mile club or Just Move. The 100-Mile program required children to walk, run or wheel 100 miles throughout the school year. The Just Move program was classroom structured. It integrated PA breaks of both high and low intensity movements such as jumping jacks, squats, stretches, yoga) within academic material to provide children with opportunities for engaging in PA while learning. Understanding the effects of such programs over time and correlates of

participation in them among diverse schoolchildren at high risk of obesity is essential to the design and expansion of effective interventions with the potential to achieve a broad reach and attenuation of health disparities, and support children in developing healthy lifestyle habits.

1. **Physical activity and student performance at school:**

This article reviews a platter of research done on the association between physical activity and cognitive development among school age children. 54 children (second to fourth grade) were divided into 2 groups (physical activity and no physical activity). Children were given 15 minutes of aerobic exercise/ walking each day. Fourth graders showed significant better performance on woodcock-Johnson test of concentration if they had participated in physical activity prior to the test. There were no differences found on students in the second and third grades (Caterino & Polak 1999). In the study conducted by Macmohon and Gross, 54 boys were assigned to either an aerobic program or a less vigorous exercise program. All boys had average or higher scores weschseler intelligence scale for children revised intelligence test scores and had been diagnosed as learning disabled. There was no significant differences found for academic achievement.

Physical activity is well associated to improve overall health of fa person, however there aren’t enough studies to show the correlation between physical exercise and academic outcome. More investigation is needed to establish a clear relationship between physical activity and cognitive development (Taras).

1. **Aging, fitness and neurocognitive function:**

Over a period of six months, a group of researchers studied 124 previously sedentary adults, 60-75 years of age who were randomly assigned to either aerobic (walking) of anaerobic (stretching, and toning) activity. Each of the 124 participants were given a cardiorespiratory test and various cognitive tests such as task switching response capability, and stopping. These tasks were chosen because they require executive control processes and they have been shown to utilize prefrontal/frontal regions of the cortex.

In task switching subjects in the aerobic group for walking became much quicker at switching tasks than those in the anaerobic group of toning and stretching. Performance improved significantly for subjects in the aerobic but not the toning group for tasks depending on executive functions.

1. **THE IMPACTS OF AEROBIC EXERCISE AND MIND-BODY EXERCISE (YOGA) ON NEURO-COGNITION AND CLINICAL SYMPTOMS IN EARLY PSYCHOSIS - A SINGLE-BLIND RADOMIZED CONTROLLED CLINICAL TRIAL**

The current study aims to explore the effects of aerobic exercise and mind-body exercise (yoga) on cognitive functioning and clinical symptoms in female patients with early psychosis. The potential neuro-mechanism underlying the clinical consequences was also investigated.

In this study a group of female patients diagnosed with schizophrenia spectrum disorders, brief psychosis, psychosis NOS, or delusional disorder (according to SCID) were recruited from three hospital/clinic sites. They were randomized into integrated yoga therapy group, aerobic exercise programme group, and waiting list as the control group. Both interventions were held three times weekly. At baseline and at 12 weeks, clinical symptoms, cognitive functions, quality of life and fitness levels were assessed in all participants, and completed structural MRI data were collected in 58 patients. Repeated measures ANOVA and ANCOVA analyses of the clinical, cognitive, quality of life and fitness data were compared between baseline and at 12 weeks among the three groups.

The results showed completed clinical and cognitive data were collected in 85 patients, and completed MRI imaging data of good quality were collected in 39 patients. No significant differences in age, education years, and duration of the illness at baseline were observed among the three groups. Both yoga and aerobic exercise groups demonstrated significant improvements in verbal encoding, short-term memory, long-term memory and working memory with moderate to large effect sizes compared to control groups. The yoga group showed significantly enhanced attention and concentration. Both yoga and aerobic exercise significantly improved overall clinical symptoms and depressive symptoms after 12 weeks. Significant increases were observed in the thickness of the left superior frontal gyrus and the right inferior frontal gyrus in the aerobic exercise group. Significant increases were observed in the volume of the postcentral gyrus and the posterior corpus callosum in the yoga group. There was a statistically significant correlation between improvements in working memory and changes in the postcentral gyrus after controlling for the multiple comparisons with a Bonferroni adjusted alpha level.

The researchers believe that both types of exercise improved memory in early psychosis

patients, with yoga having a superior effect on attention than aerobic exercise. Observed increments in the cortical thicknesses and volume may indicate improved neurogenesis (Lin, Jessie Jingxia, Lee, HM, Chan, K.W., Chang, W.C., Su, Wayne, Honer, William G., . . . Chen, E.Y.H. 2014).

1. **A review of chronic and acute physical activity participation on neuroelectric measures of brain health and cognition during childhood**

There has been a rise of a new trend of inactivity amongst the youth of today. Childhood inactivity leads to a sedentary adult lifestyle as well (Hillman, Kamijo, & Scudder). However, absent from public health concerns is the impact that physical inactivity may have on brain health and cognition. Many school districts have obviated physical activity opportunities from the school day despite a growing literature indicating the benefits of physical activity to cognitive and scholastic performance. Such educational practices are growing in popularity due to budgetary constraints and an increased emphasis placed upon student performance on standardized tests. It is counterintuitive that spending less time in the classroom and more time engaged in physical activities might improve cognition and learning, yet human and non-human animal research is consonant in suggesting that physical activity benefits brain health and cognition.

A review of studies examining physical activity and neuroelectric concomitants of cognition during childhood is described. When applicable, research involving adult populations is also described to better inform on this relationship in children. Results. Collectively, the data support a beneficial relation of chronic and acute participation in physical activity to brain health and cognition. The results suggest more effective allocation of cognitive processes involved in stimulus engagement and action monitoring during tasks requiring variable amounts of cognitive control in children.

The conclusions of this study were that physical activity may influence brain health and cognition in children, leading to enhanced scholastic performance and greater overall effective functioning across an individual’s life span( Hillman, Kamijo, & Scudder 2011).

1. **Classroom-based physical activity, cognition, and academic achievement**

This study was conducted on the bases that there is an increase in the association between physical activity and cognitive functioning. Evidence suggests that there may be a link of these aspects to academic achievement. After examining the classroom based physical activity on body mass index and academic achievement, the data supported that there was a link between physical exercise and academic achievement. The role of physical activity in the classroom was also supported by the Physical Activity Across the Curriculum (PAAC) project. Physically active academic lessons of moderate intensity improved overall performance on a standardized test of academic achievement by 6% compared to a decrease of 1% for controls. Body mass index increased less from baseline to 3 years in students with greater than 75 minutes of PAAC lessons per week (1.8 BMI) compared to students with less than 75 minutes of PAAC per week (2.4 BMI).

The researchers concluded that further examining the effects of physical activity and academic achievement is still needed. The impact of physically active academic lessons of greater intensity may provide larger benefits for body mass index and academic achievement (Donnelly, Joseph E., & Lambourne, Kate 2011).

1. **THE EFFECT OF ACUTE TREADMILL WALKING ON COGNITIVE**

**CONTROL AND ACADEMIC ACHIEVEMENT IN PREADOLESCENT**

**CHILDREN**

In this study, researchers assessed the effects of an acute bout of moderate treadmill

walking on behavioral and neuroelectric indexes of the cognitive control of attention and applied aspects of cognition involved in school-based academic performance. There were 20 preadolescent participants to assess exercise-induced changes in performance during a modified

flanker task and the Wide Range Achievement Test 3. The resting session consisted of cognitive testing followed by a cardiorespiratory fitness assessment to determine aerobic

fitness. The exercise session consisted of 20 min of walking on a motor-driven treadmill at 60% of estimated maximum heart rate followed by cognitive testing once heart rate returned

to within 10% of pre-exercise levels.

The results indicated that there was improvement in response accuracy and better performance on academic achievement tests following aerobic exercise relative to resting session.

Collectively, these findings indicate that single, acute bouts of moderately-intense aerobic exercise (i.e. walking) may improve the cognitive control of attention in preadolescent children,

and further support the use of moderate acute exercise as a contributing factor for increasing attention and academic performance. These data suggest that single bouts of exercise affect specific underlying processes that support cognitive health and may be necessary for effective functioning across the lifespan (Hillman, Pontifex, Raine, Castelli, Hall, & Kramer 2009).

1. **The effects of single bouts of aerobic exercise, exergaming, and videogame play on cognitive control**

The objective of this study was to determine the effects of single bouts of aerobic exercise, exergaming, and action videogame play on event-related brain potentials (ERPs). Task performance indices of cognitive control were investigated using modified flanker test that manipulated the demands of attentional inhibition. The participants completed four 20 min sessions of activity intervention (seated rest, seated videogame play, and treadmill-based and exergame-based aerobic exercise at 60% HRmax). Once the heart rate returned to 10% pre-activity levels, the participants were given a cognitive test.

The findings indicate that single bouts of treadmill exercise may improve cognitive control

through an increase in the allocation of attentional resources and greater interference control during cognitively demanding tasks. However, similar benefits may not be derived following short bouts of aerobic exergaming or seated videogame participation ( O’leary, Pontifex, Scudder, Brown, & Hillman 2011).

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